Enhancing of lasing efficiency in thin layers of cholesteric liquid crystals by suppressing the lasing modes leakage

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Lasing in liquid crystals (LC) has many attractive properties. One of them is a possibility of creating the lasing panels with a large optical aperture. Such panels can contain many of individual elements (pixels) controlled by an electric field [1]. Thus, in principle, one can imagine a new generation of lasing information displays (LID), where a whole panel area is optically or electrically pumped, while a local lasing effect is defined by an information content controlled by an electric field at individual pixels. There is, however, a serious problem in this virtual example of LID. This problem is tightly connected to the fact that the thickness of LC layer is significantly lower than the size of the whole aperture (pumping area). As it is discussed in this work, the leaky lasing modes can appear at this condition. These modes get out into the substrate and propagate therein either due to the total internal reflection or by sliding along the substrate plane at very small angles with respect to their surfaces [2]. The sliding modes have very low lasing threshold. In the case of cholesteric liquid crystal (CLC) layers these lasing modes provide energy leakage. It is a serious parasitic effect, which is decreasing the lasing efficiency along the cholesteric helix axis and can even completely suppress the lasing effect at edges of the photonic band.

In this work we consider general properties of the lasing modes leakage and methods to suppress it. In particular, numerical simulation and experimental data are presented for the case when thin polymer layers providing absorption in a specified spectral range of lasing leakage are used for CLC alignment. With such alignment layers we have achieved significant suppression of the lasing modes leakage. The lasing effect at long wave edge of the CLC photonic band takes place even at large pumping area, while in the case of similar CLC layer without the absorbing alignment layers the lasing is observed at the same pumping intensity only if the pumping beam is well focused.

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(2) L. M. Blinov, G. Cipparrone and P.Pagliusi, V.V. Lazarev and S.P.Palto. Mirrorless lasing from nematic liquid crystals in the plane waveguide geometry without refractive index or gain modulation, *Appl.Phys.Lett.* **2006**, *89*, 0311114.